# Brief Communication Communication brève

## Clinical outcome of calves with failure of passive transfer as diagnosed by a commercially available IgG quick test kit

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**Abstract —** The efficacy of an IgG quick test in detecting calves with failure of passive transfer was assessed. The test was carried out on 97 male calves, 38% of which were negative (IgG < 10 mg/mL). Morbidity and mortality due to infectious diseases were significantly higher in the negative group showing that the quick test is useful in identifying calves more susceptible to infectious disease.

**Résumé — Résultats cliniques chez des veaux souffrant d'échec de transfert passif d'immunité diagnostiqué à l'aide d'une trousse commerciale de détection rapide d'IgG.** L'efficacité d'un test de détection rapide d'IgG pour détecter l'échec du transfert passif chez les veaux a été évaluée. Le test a été réalisé sur 97 veaux mâles et 38 % ont obtenu des résultats négatifs (IgG < 10 mg/mL). La morbidité et la mortalité attribuables aux maladies infectieuses étaient considérablement supérieures dans le groupe négatif, indiquant ainsi que le test rapide est utile pour identifier les veaux plus susceptibles aux maladies infectieuses.

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Bovine placental structure does not allow transfer of large molecules, including immunoglobulins (Ig), between dam and fetus. Newborn calves, therefore, have almost no antibodies unless they are infected in utero when very low levels of Ig might be produced (1). Circulating levels of self produced IgA, $IgG_1$, and $IgG_2$ do not reach significant levels in calves until 16 to 32 d after birth. This means that the bovine immune response is not efficient for at least 2 to 4 wk after birth and so the newborn calf relies largely on passive immunity transferred from the adult female via colostrum (1).

Immunoglobulins are present in the colostrum in different concentrations: $IgG_1$ (80%), $IgG_2$ (5% to 10%), IgM (5%), and IgA (5% to 7%). The most abundant immunoglobulin in colostrum is IgG, which shows higher serum levels in colostrum-fed calves (2,3). Reduced absorption of maternal immunoglobulins by calves is designated as failure of passive transfer (FPT). A management target of 10 mg/mL has been suggested as the minimum level of IgG in the serum of calves aged 24 h to exclude FPT (4,5).

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Adequate transfer of maternal immunoglobulins is associated with short- and long-term health advantages by reducing pre- and post-weaning mortality due to infectious disease and increasing daily gain, feed efficiency, fertility, and milk production in first and second lactation (6–8). So FPT constitutes an economic, public health, and animal welfare issue because it is responsible for a higher level of disease, longer rearing period, and increased use of antimicrobials in calves. Being able to identify calves with FTP before they enter the farm reduces the prevalence, excretion and circulation of infectious agents; disease morbidity; antimicrobial use and bacterial resistance; welfare problems; and mortality; and encourages better management at the dairy farm level (9).

The objective of this study was to evaluate the diagnostic efficacy of a commercial quick IgG test (Plasma Calf IgG Midland Quick Test Kit, Midland Bioproducts Corporation, Boone, Iowa, USA) for the identification of calves susceptible to infectious disease when entering a fattening unit. The test used in this study has been compared with radial immunodiffusion assay in calves under 15 d of age (10). Sensitivity and specificity of the blood IgG immunoassay test to detect IgG > 10 mg/mL were 0.93 and 0.88, respectively, compared with 1.00 and 0.53 for the sodium sulfite test. For refractometry, sensitivity and specificity were 0.71 and 0.83, respectively.

The animals used in this study belonged to a single large dairy calf fattening unit that receives young (up to 30 d old) male calves bought from many dairy farms. Most are Holstein-Friesian, but some crossbreeds usually appear (Holstein × Limousine and Holstein × Blue Blanc Belge). Transport distances from dairy farms vary from 2 to 200 km. On arrival, the calves are placed in individual hutches, previously washed and disinfected, with a clean straw bed and a small exercise area. All

calves receive an electrolyte solution immediately after getting into the hutch. The first milk (18% fat; 20% protein) is fed 2 to 3 h after arrival. No medicated milk was used during the study. Starter ration is fed "ad libitum" from the day of arrival. After weaning, at approximately 2 mo of age, the calves are grouped in large paddocks.

Every morning a stockperson makes a round to identify sick animals. The person responsible for giving the milk also reports any problem with the animals. Once an animal with a health problem is detected, the main clinical signs are registered and treatment is initiated. Various antimicrobials (oxytetracycline, florfenicol, danofloxacin, or tilmicosin) are used for enteric, respiratory, or other infectious disease. Flunixin-meglumine is also used in most sick animals.

One hundred calves under the age of 15 d were included in the study. Three calves were subsequently removed from the study due to non-infectious disease (2 due to bloat and 1 to trauma). On arrival, a physical examination was performed on each calf and only those that didn't show clinical signs of past or present disease and had a rectal temperature $< 39.5$°C (103°F), were included in the study. The most frequent reasons for exclusion were: high temperature, signs of diarrhea or respiratory disease, including bald skin on hind limbs, dehydration, and umbilical swelling with pain at palpation.

After clinical examination, 7 mL of blood was taken from the jugular vein into a heparinized tube, and 5 mL into an EDTA tube. Heparinized blood was centrifuged immediately and plasma was used for the IgG detection test. The quick test kit detects, via a qualitative immunodiagnostic assay, the circulating levels of IgG $> 10$ mg/mL. The immunoassay was performed and read according to the manufacturer's instructions (see http://www.midlandbio.com/). The visualization of even a slight response was considered a negative result (IgG $< 10$ mg/mL). The blood in the EDTA tubes was refrigerated and hemograms were performed 2 or 3 h later at the Faculdade de Medicina Veterinária by technicians who were blind to the study and who used an impedance and optical counter (Cell Dyn 3700; Abbott Diagnostic Division, Abbott Park Illinois, USA).

The identification and treatment of diseased animals was done by the farm workforce, blind to the tests results. All infectious diseases, treatments with antimicrobials, and deaths were registered until weaning (60 d of age).

Differences among continuous variables were evaluated by one-way analysis of variance (ANOVA) considering positive or negative for the IgG test as the fixed factor. Categorical variables such as mortality and morbidity were studied as rare events. Confidence intervals were estimated and compared, taking into account that variables follow a Poisson distribution. Statistical analysis was done using SPSS 14 for Windows (StataCorp, College Station, Texas, USA).

Table 1 shows the results of the IgG test, the average CBCs, and the morbidity and mortality incidence of the 97 calves included in the study. Sixty calves (62%) were positive to the test, showing protective IgG levels, and 37 (38%) were negative to the test and considered to have FPT. The hemogram did not detect differences between groups except for the significant lower concentration of lymphocytes in the FPT group. Animals

**Table 1.** Blood parameters, morbidity, and mortality in calves with or without adequate plasma IgG levels when entering a fattening unit

| | Test result | |
|---|---|---|
| | Positive[b] | Negative[c] |
| *Calves* | | |
| *n* | 60 | 37 |
| Mean age (days)[a] | 11.5 | 12.1 |
| *Hemogram* | | |
| Mean ± *s*, RBC ($\times 10^6/\mu$L) | 7.62 ± 0.29 | 8.10 ± 0.21 |
| Mean ± *s*, WBC ($\times 10^3/\mu$L) | 9.84 ± 0.69 | 10.35 ± 0.88 |
| Mean ± *s*, PVC (%) | 27.82 ± 1.17 | 29.97 ± 1.02 |
| Mean ± *s*, Neutrophils/μL | 5529 ± 669 | 7179 ± 892 |
| Mean ± *s*, Limphocytes/μL | 4006 ± 424[#] | 2652 ± 333[#] |
| Mean ± *s*, Monocytes/μL | 259 ± 43 | 505 ± 93.13 |
| Mean ± *s*, Eosinophils/μL | 8 ± 7.13 | 10.48 ± 6.3 |
| *Clinical outcome* | | |
| Number with disease | 10[#] | 21[#] |
| % with disease | 16.7[#] | 56.8[#] |
| Number of deaths | 1[#] | 6[#] |
| % that died | 1.7[#] | 16.2[#] |
| *Number of treatments*[d] | | |
| Respiratory disease | 9 | 18 |
| Enteric disease | 10 | 18 |
| Umbilical disease | 0 | 2 |
| Mean treatments per animal | 0.32[#] | 1.02[#] |

[#] Values in the same line differ ($P < 0.05$).
*s* — standard deviation.
[a] Age at IgG testing.
[b] Positive = Plasma IgG $> 10$ mg/mL.
[c] Negative = Plasma IgG $< 10$ mg/mL.
[d] Total treatments applied.
WBC — white blood cells; RBC — red blood cells; PCV — packed cell volume.

from the "Negative Group" (IgG $< 10$ mg/mL) showed a higher morbidity to infectious diseases than the "Positive Group" (56.8% versus 16.7%, respectively) and a higher level of mortality (16.2% versus 1.7% respectively). The number of antimicrobial treatments needed for animals in each group also showed a significant difference — the positive group required 19 treatments for 60 animals and the negative group needed 38 treatments for 37 animals.

The 38% of dairy calves showing FPT in our study is in accordance with what is reported in other countries. The National Animal Health Monitoring Systems (NAHMS) reported that 40% of calves in USA dairy farms showed IgG levels under 10 mg/mL and 27% were under 6.2 mg/mL (11). McVicker et al (12), comparing different IgG measuring tests, found that 56% of 204 calves included in their study had FPT. Weaver et al (13) report a much broader range suggesting that between 10% and 60% of calves do not receive adequate maternal protection. However, the prevalence of FPT in our study may not reflect what happens at the dairy farm level because only male calves were included in this study. Knowing that well-managed farms are much more careful in colostrum-feeding female newborn calves, because failure to do so would mean loosing good genetics, it is expected that the percentage would be reduced if neonates of both sexes were tested.

Failure in immunoglobulin transfer to the neonate is considered responsible for reduced resistance to disease and increased mortality in calves during the first months of life (1,14). Wells et al (6) estimated that 31% of the mortality events occurring

within the first 3 wk of life could be attributed to FPT of immunity. Other authors found that 39% of the 8.2% mortality rate in dairy calves up to 4 mo was attributable to FPT (15). Earley and Fallon (9) concluded that young dairy calves purchased from markets were more susceptible to respiratory disease because of low levels of serum immunoglobulins. Our results also showed that calves negative to the test were much more susceptible to disease and had to be treated more often. However, the mortality incidence was above what is depicted in some surveys: the NAHMS (USA) showed that 10% of calves with FPT died during the first 60 d (11). This higher mortality may be the result of several predisposing factors found at this particular farm: high animal density, numerous source farms, stress caused by travelling, and poor hygiene.

Costs with treatments (average $5.4 CAN per treatment) and mortality ($150 CAN per dead calf) were analyzed. Not considering the reduced income due to reduced growth, the total losses due to FPT were calculated to be $1105 CAN, in contrast with $254 CAN for the test-positive group. The price for each test was, at the time of the study, approximately $8 CAN.

In conclusion, the Plasma Calf IgG Midland Quick Test for measuring IgG levels in calf blood is a useful tool for the early detection of calves < 15 d of age that are more susceptible to infectious disease. This may be advantageous to veal farms because it allows the early separation of more susceptible calves, implementation of a specific vaccination program, reduction in antimicrobial use and, permits refusal of animals from dairy farms in which colostrum management is not adequate.

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